To all whom it may concern:

Be it known that I, Timothy O'Connell, citizen of the United States, and resident of Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Processes of Producing Carbon-Hydrogen Gas, of which the following is a specification.

This invention relates to the art or process of producing carbon-hydrogen gas.

One object of my invention is to provide an improved method for operating a gas generator, whereby a greater quantity of coal and hydrogen gas may be produced, from the same amount of coal.

Another object of my invention is to provide an improved method of treating the coal to produce not only a greater quantity of gas, but also, to eliminate the formation of hard, solid clinker.

Another object of this invention is to provide an improved method for producing gas in a considerably shorter time than is possible to produce through the present operation of a generator, to produce so-called soft clinker, formed by the burning of the coal, and to cause the clinker to collapse in such a way, as to permit the reacting agents, passing through the coal, to freely act upon a greater number of coal particles, than is possible by the methods used to-day.

A still further object of my invention is to provide a certain way of coaling the generator during the operation of my improved gas-producing process.

Other objects of the invention will appear more fully from the following description, reference being made to the accompanying drawings, in which an appropriate machine for producing gas is diagrammatically illustrated, and in connection with which the process will be better understood.

Referring to the drawings; a basement floor is shown, designated by 10, upon which rests a generator 11 equipped with the usual grates 12. Beneath the grates enters into the generator a blast pipe 13, provided with a valve 15, and which conveys air under pressure in the coal above the grates entering through hand operated nozzle 113.

Opposite the blast pipe 13, and located also beneath the grates, is a pipe connection 14, through which steam under pressure may be forced into the burning coal, while a similar pipe connection 15, is provided near the top of the generator, through which steam may be forced downward into and through the burning coal. Opposite the pipe connection 15, is located the producer or water gas pipe 16, which deflects downward at 17, terminating in the dust pocket 18. Another portion 19, of the producer or water gas pipe 16 is deflected upward and into the carburetter 20. Next to the generator wall, pipe 16 is provided with a valve 21 which may be opened or closed at will. Valve 13 is similarly operated and both valves 21 and 13 are handled in such a way that when air is forced into the generator by way of independently operable nozzle 70 and through pipe 15, the valve 21 is opened; when steam enters through pipe 14, valve 21 is opened while valve 13 has been closed; and when steam is forced through pipe 15, valve 21 is to be closed and valve 13 is to be opened.

The produced producer or water gas passes through the producer or water gas pipe 19 into the carburetter 20, on top of which is provided a pipe connection 22 through which oil is sprayed at certain intervals into the gas.

The oil-mixed gases then travel downward between the outer wall of the carburetter and the dividing wall 23 into the superheater 24, the top of which is provided with a duct 25, which may be opened or closed by valve 26. Above the duct 25 a purge stack 27 serves for receiving and conveying draft-gases when the valve 26 is opened. When producing producer or water gas the valve 26 remains closed and the gas is forced to travel through the pipe 22, the wash-box 30 into the gas main 31. An operating valve 22 in the gas main 31 serves for closing the latter, when an air blast is made through the machine, during which period the valve 26 is opened. At the bottom of the superheater, a cleaning door 28 is provided.

The usual equalization or balancing means, consisting of pipe 33, the seal pot 33', the branch pipe 34 and the main pipe 35, are connected with the wash-box.

Pipe 33 is open at its upper end through which water in the wash box 30 is conveyed to seal pot 33'. When the water in the seal pot reaches the height of pipe 34 it overflows therethrough into the main pipe 35, which leads to a separator, not shown in the drawings. From this separator the water is forced into the wash-box again through con-
venient means, not shown, and the oil gained is reused afresh.

The construction of a producer or water gas generator is well known and its dia-
grammatical plan shown in the drawing is to serve purely for the purpose of expla-
ation. The dashed lines 36 and 37 indicate where solid clinker is formed by operating the gen-
erator with present processes, while 38 is the highest mark up to which coal is deposited.

It is important to generally explain the heretofore used methods of operating the generator in order to comprehend the sig-
nificance of my improved process, based upon actual and personal experience.

It will be also easier to understand how the different operations follow each other, when a few technical terms are first ex-
plained.

For instance by the word “run” is generally meant a time period, consisting of two equal parts, for example a “run” may con-
sist of a period of eight minutes, which are divided into a “blast,” which means a four minute period during which air is forced into the generator, and a “make,” which means a four minute period during which steam is forced for say 3 minutes from the top through the coal, and for one minute from the bottom.

During such “run” oil is sprayed into the carburetor, and as this forms a part of each “run,” it will not be mentioned specially hereafter. During the “blast,” valves 13’ and 21 and 26 are opened, while valve 32 is closed.

During the first period of the “make,” which is called “down-blow,” the valve 21 is closed and the valve 13’ is opened.

The gases generated during the down blow pass through blast pipe 15 into the pro-
ducer gas pipe 19 behind the then closed valve 21, as indicated at 13’.

During the second period of the “make,” which is called “up-blow,” the valves 21 and 32 are open, while the valves 13’ and 26 are closed. All of the valve operations in conjunction with the different “runs” are self explanatory and self-evident and will therefore not be referred to hereafter.

The old operation, now in use, provides, within one run comparatively long periods of down-blows against blasts of inadequate length, and up-blows of too short a duration.

The result is that a hard, solid clinker is formed directly above the grate and similar clinker formations take place upon the walls of the generator, preventing, together with the grate-clinker, the desired penetr-
ation of steam through the burning coal. Moreover the contact surface, upon which the reaction of the steam is to take place, is reduced to a considerable extent. Con-
sequently a reduction of producer or water gas generation follows. Through the ex-
cess supply of steam during the down-blows, the fire is unduly quenched, and clinker forms, containing unburned and unused coal 70 particles, and covers the fire. The unburned coal particles represent actual waste.

In order to prepare the coal for generat-
ing gas again, a longer blast period is re-
quired and the coal nearest to the grate 75 totally burns before having served to pro-
duce hydrogen.

When cleaning the fire, the mass of clinker, forming practically a solid sheet over the burned coal, has to be removed by 80 force, which operation consumes a considerable length of time.

My improved process is designed to elimi-
nate all of the foregoing defects of the hereto-
fore applied methods of firing, coaling 85 and treatments of the coal, and the pro-
duced gases.

After starting fire in the generator and having supplied the first layer of coal upon the grates, I make two “runs,” each consist-
ing of one air blast and one steam up-blow of equal duration, called a “blast-run.”

These I follow with two “runs,” each of air one blast and one “make,” the latter con-
sisting of a down-blow of ⅓ of a “make,” and 95 an up-blow of ⅔ of a “make,” which run I may call a “make-run.” Then a blast run follows.

Then three “make-runs” are made. An-
other blast run takes place and again three “make-runs” follow. After the last “make-
coaling takes place in such a manner as to distribute the coal in as nearly a horizontal plane as possible.

The coaling is followed by two “blast-
runs” and the foregoing process is repeated until the 24th run is made and another coaling in the similar way takes place. The process is again repeated up to the last coaling before cleaning the fire, which might 100 be at the 72nd run.

After that last coaling the usual two blast runs take place; the following runs, how-
ever, are different and consist of a blast and a make of equal length, the make how-
ever being divided into a down-blow of ⅔ of a make and an up-blow of ⅓ of a make.

The last kind of runs, which I may call “final runs”, continue until the fire is cleaned.

In the aforeexplained method I correctly consider a “run” as a time unit, as I have ex-
perienced that, when the “runs” are made in the described succession, and are properly divided into blasts and steam up-blows, and 115 blasts and makes, and when the proportion of down and up-blows within such makes is made in the prescribed proportion, the desired results are obtained.

Nevertheless I shall endeavor, for clear-
ness' sake, to repeat my process of operation once more, at the point when the first layer of coal is ignited, taking as base a run of eight minute duration and using a table for simplicity.

<table>
<thead>
<tr>
<th>Run No.</th>
<th>Blast</th>
<th>Steam</th>
<th>Oil</th>
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<tbody>
<tr>
<td></td>
<td>Up</td>
<td>Down</td>
<td>Up</td>
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<td>3</td>
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</table>

It will be found that, by following my improved method of operation, usable gas will be produced almost immediately at the first "make-run", that the clinker will not contain any unused coal particles, that the clinker will form a fine, porous, light and very brittle substance, that the contact surface of the burning coal will be increased, whereby the reaction of steam upon the coal is amplified, and that a reduction of fuel consumption is taking place, while gas of better quality and of increased volume per pound of coal is produced.

Owing to the fact that very light and spongy clinker is formed the cleaning of the fire is greatly facilitated especially because the clinker clinging to the generator walls will collapse by its own weight and does not necessitate its being broken up by force. The cleaning process will consume therefore a minimum length of time with a negligible exertion of strength, and efforts.

It is not to be forgotten that, together with the air and steam reaction process upon the coal, a peculiar coaling operation is required, which consists of depositing fresh coal at the center of the fire and keeping the burning coal in as nearly a perfectly horizontal plane as possible during the entire process.

Having thus described my improved method, I claim:

1. A process of efficiently producing carbon-hydrogen gas in a generator, which comprises subjecting the first layer of ignited coal to an air blast and a steam blow, both of equal length and directed from beneath the coal, to another air blast and steam blow similar to the former, to an air blast, to a steam-blow directed from the top and lasting 3/4 of the air blast, to a steam blow from the bottom lasting 3/4 of the 70 blast, to a succession of two periods of operations, each period comprising an air-blast and a steam up-blow of equal length, followed by three operations, each consisting of an air blast, a steam down-blow of 3/4 of the blast period and a steam up-blow of 3/4 of the blast period of depositing coal in the center of the fire after the last steam up-blow, following the coaling up with 2 periods of air blast and steam up blows of equal length and continuing the process in the above described order, including the coaling until the last coaling operation before cleaning of the fire has taken place and has been followed up by a double air blast and steam up-blow, subjecting the thus prepared coal up to the point of cleaning to a series of operations consisting of air blasts, steam down-blow of 3/4 of the air blasts, and steam up blows of 3/4 of the air blast periods.

2. A process of producing carbon-hydrogen gas in a generator as set forth in claim 1 spraying oil into and mixing it with the produced gases for a period of 3/4 of each air blast and at each steam blow period.

3. A process of producing carbon-hydrogen gas in a generator, as set forth in claims 1 and 2, depositing fresh coal at each coaling period substantially at the center of the fire and spreading the newly ignited coal in a substantially horizontal plane.

4. The process of producing carbon-hydrogen gas in a generator, which comprises subjecting the first layer of ignited coal to a series of reactions called "runs," each comprising a period of air blast of half duration of a run, the other half of the "run" comprising either a steam up-blow of the length of an air blast, and called a blast run, or of a "make" comprising a period of 110 3/4 of a blast for a steam down-blow and 3/4 of a blast for a steam up-blow, called a make run, or of a "make" proportioned 3/4 to 3, called a final run, said series of runs progressing as follows: two blast-runs, two 115 make-runs, one blast run, three make runs, one blast run, three make runs, coaling, two blast runs, and so on until the last coaling before cleaning of the fire has taken place, two blast runs after the last coaling and finally 120 runs continuing until the cleaning takes place.

5. The process of producing carbon-hydrogen gas as set forth in claim 4 spraying oil into and mixing it with the gases at each run for a period of 3/4 of a run.

6. The process of producing carbon-hydrogen gas in a generator, which comprises subjecting the first layer of ignited coal to a series of reactions called runs, each run 150...
lasting for 8 minutes and divided into a 4-minute air blast period during which air is forced through the coal from its bottom, and another 4-minute period consisting either of a four-minute steam up-blow, in which case the run is called a blast run, or of a 2½-minute steam down-blow and a 1½-minute steam up-blow period, such run being called a make-run, and finally of a 3½-minute steam down-blow and a 1½-minute steam up-blow period, called a final run, starting with two blast runs, and continuing with two make runs, one blast-run, three make-runs, one blast run, three other make-runs and coaling after the last make-run; two blast runs, and so on until the last coaling before cleaning the fire, and following it with two blast runs and a series of final runs until the cleaning of the fire takes place, spraying oil into and mixing it with the gases at each run for 3 minutes per run.

7. The process of producing carbon-hydrogen gas in a generator as set forth in claim 6, depositing at each coaling period a layer of fresh coal substantially in the center of the fire and spreading the newly ignited coal in a substantially horizontal plane.

Signed at New York, in the county of New York and State of New York, this 5th day of September, A. D. 1919.

TIMOTHY O'CONNELL.